Optimizing production input in *Brassica* crops for the different soil zones of Saskatchewan

Y. Gan[1], S. Brandt[2], S. Malhi[3], R. Kutcher[3], and F. Katepa-Mupondwa[4]
Agriculture and Agri-Food Canada [1]Swift Current, [2]Scott, [3]Melfort, and [4]Saskatoon, SK

INTRODUCTION

Canola-quality *Brassica juncea* (i.e., *juncea* canola) has equal or superior seed and meal quality to conventional canola species. This non-GMO crop may provide growers in western Canada with options for diversifying canola production. In the dry areas of southwestern Saskatchewan and southeastern Alberta, conventional canola (i.e., Polish and Argentine canola) often suffer from heat and drought stress during the flowering period (Miller et al. 2001), which causes abortion of flowers, failure to fill developing pods (Morrison and Stewart, 2002), and reduced seed yields (Angadi et al. 2000). The newly developed canola-quality *Brassica juncea* performs better than the conventional canola species when conditions are stressful (Gan et al. 2003b). However, this has not been compared with hybrid canola and other canola species under different soil-climatic conditions.

Brassica crops require adequate nitrogen (N) for maximum productivity (Miller et al. 2001). Canola responds to nitrogen positively in the Parkland regions even when nitrogen fertilizer was applied at a rate as high as 180 kg N ha^{-1} (Brandt et al. 2002). However, an economically optimum nitrogen level has not been determined. Hybrid canola varieties seem to respond to nutrients more aggressively than open-pollinated varieties, but again an economically profitable fertility level has not been established for hybrids in comparison to open-pollinated varieties. The maximum economic return per unit of input can only be captured when an economic threshold of fertility levels is established.

OBJECTIVES

The objectives of this study are: 1) to understand how *Juncea* canola interacts with varying soil and climatic conditions in the Brown, Dark Brown and Black soil zones, 2) to determine the effect of nitrogen fertilization on plant growth, development, seed yield and quality, and 3) to develop economically optimum fertility curves for each environment for *Juncea* canola in comparison with conventional mustard, conventional canola, and hybrid canola.

MATERIALS AND METHODS

Five oilseed crops, *Brassica napus* L. (cv. Invigor 2663*)*, *B. rapa* L. (cv. Hysyn 110*), B. juncea* L. mustard (cv. Cutlass), *B. juncea* L. canola (c.v. Amulet), and *S. alba* (cv. AC Base), were evaluated at seven rates of nitrogen (0, 25, 50, 100, 150, 200, 250 kg/ha) at four Saskatchewan sites (Melfort, Scott, Saskatoon, and Swift Current), in 2003 and 2004. The experiment was a factorial randomized, complete block design with 4 replicates. Prior to seeding, all amounts of fertilizers were broadcasted and then incorporated into soils with a shallow rotary tillage or were applied using a seeder equipped with a splitter for application of high rates of N. Plots were seeded immediately after all fertilizers were applied. Seeding rate was 160-240 viable seeds m^{-2}, targeting 80-100 plants m^{-2}. Yield response curves of these species to N input were developed for each site (except Saskatoon where data are not available at this time). Comparisons were made between mustard and canola, between conventional and hybrid canola, and between oriental and yellow mustard.

RESULTS AND DISCUSSION

Averaged over the years and locations, hybrid canola (Invigor 2663) produced the highest seed yield, followed by conventional mustard (Cutlass), and yellow mustard (AC Base) produced lowest seed yield (Fig. 1). At Swift Current, hybrid canola yielded 20% higher than other oilseed species. Hybrid canola may provide producers in the dry region with a high yielding oilseed crop alternative. The relatively low seed yield of yellow mustard was in part attributed to poor pod filling, as many pods had few or no seed.

In the range of N from 0 to 150 kg/ha, all the five oilseeds responded positively to N application at both Swift Current and Melfort (Figs. 2 and 3). Hybrid canola had the strongest response to N fertilizer and yellow mustard the weakest. On average, maximum seed yield was achieved at 150 kg N/ha of fertilizer at Swift Current (Fig. 2), and at 200 kg N/ha at Melfort (Fig. 3). At these sites, the N response curves were fairly similar for all crops, suggesting that N management strategies should be similar for all of these oilseeds. Our data does not support any suggestion that higher yielding types would require more fertilizer N, but rather that they use N more efficiently to achieve higher yield with the same amount of N.

At Melfort, the supply of N from the soil was small, and yield in the absence of fertilizer N was low [600-800 kg/ha]. This was likely because previous crops had depleted soil N and the capacity to supply N was relatively low on this low organic matter Gray Luvisol. However, the supply of moisture was good, and fertilizer N allowed the crops to respond to moisture and produce maximum yields in the range of 1400-2000 kg/ha. At Swift Current, the soil supplied sufficient N to support moderate yield in the 800-1300 kg/ha range. Because the supply of moisture at this location was abundant, maximum yields were higher than the other locations. In a normal year, moisture supply at Swift Current is lower than for the other locations. The results clearly demonstrate the variability that occurs in this drier region.

At Scott, application of fertilizer N did not affect seed yields (Fig. 4). This region has experienced severe drought during 2001 to 2003, resulting in poor crop yields and subsequent build up of soil residual nutrients. Yields in the absence of N application were relatively high [1000 -1500 kg/ha]. In the experimental years, soil moisture at Scott was limited, and N did not enhance yield. It should be noted that where moisture is favourable, preceding crops would deplete soil N, and that with continuing favourable moisture fertilizer N will be essential to optimize yield.

CONCLUSION

This multiple site/years study determined the range of yield responses from fertilizer N supply and also demonstrated the need to account for N supplied from the soil in estimating the most appropriate amount of N to apply. Moisture plays a big role in N responses in *Brassica* crops. It is desirable to continue these studies to obtain a better sampling of moisture conditions that would facilitate generating N response curves over a range of moisture conditions.

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Fig.1. Seed yield of oilseed species in different sites averaged over 2003 and 2004.

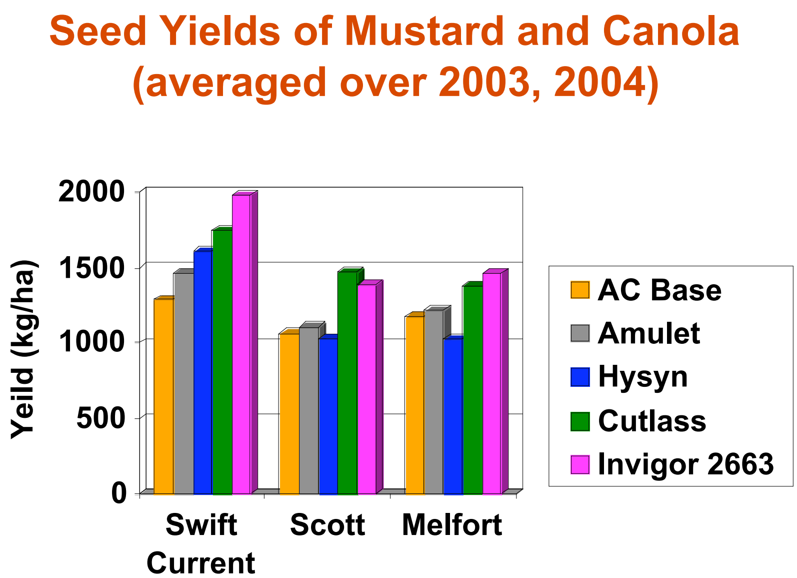

Fig.2. Seed yield response of oilseed species to N fertilizer at Swift Current, 2003-2004

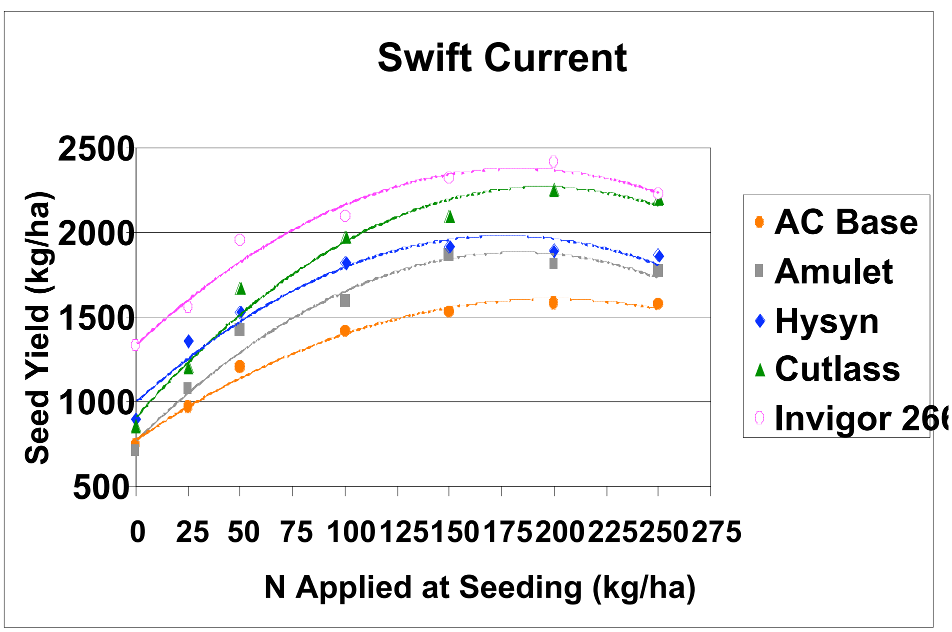

Fig. 3. Seed yield response of oilseed species to N fertilizer at Melfort, 2003-2004.

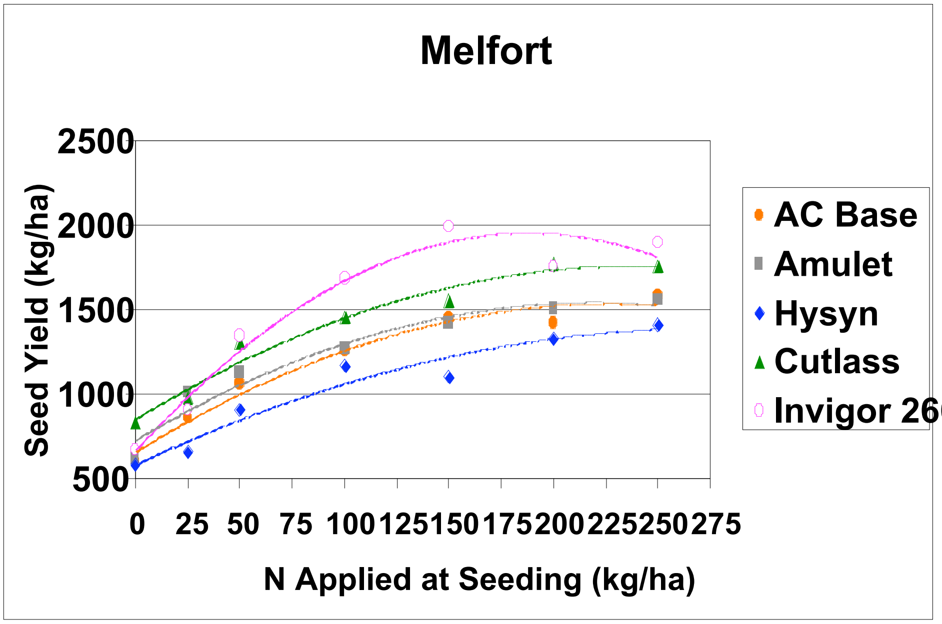

Fig. 4. Seed yield response of oilseed species to N fertilizer at Scott, 2003-2004